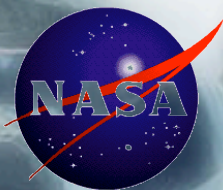


NASA ENERGY AND WATER CYCLE STUDY



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NEWS Working Group Co-Chairs:

Drought & Flood Extremes: X. Dong & J. Albertson

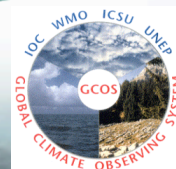
Evaporation & Latent Heating: K. Hilburn & J. Famiglietti

Energy & Water Cycle Climatology: M. Rodell & T. L'Ecuyer

Modeling & Water Cycle Prediction: M. Bosilovich & Y. Hu

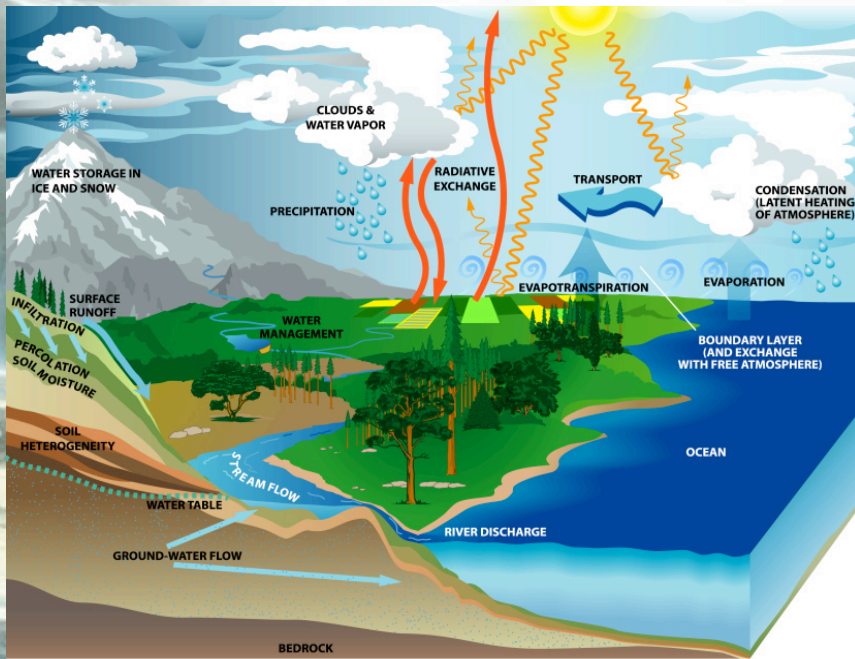
NEWS Challenge:

Document and enable improved, observationally-based, predictions of water and energy cycle consequences of Earth system variability and change.



The Water and Energy Cycle

Is the water cycle accelerating?



Why NEWS?

Need the collective of NASA & community information and expertise to ask (and define) the larger questions

(aka) Need the whole to be more than the sum of the parts

Why study the water & Energy cycle?

1. Water exists in **all three phases** in the climate system and the **phase transitions** are a **significant factor in the regulation of the global and regional energy balances**
2. **Water vapor in the atmosphere is the principal greenhouse gas** and clouds at various levels and composition in the atmosphere represent both positive and negative feedback in climate system response
3. Water is the **ultimate solvent** and global biogeochemical and element cycles are mediated by the dynamics of the water cycle
4. Water is the element of the Earth system that most **directly impacts and constraint human society and its well-being.**

NEWS Components

NEWS Constraints

- Focus on energy and water processes and dynamics in the climate system.
- The NEWS challenge is a **global scale** objective
- Integrate energy and water cycle system components (observations and predictions)
- NEWS elements: **Observation, Understanding, Models, Prediction and Consequences**
- Make **decisive progress** toward NEWS challenge
- NASA administers the energy and water cycle focus area as an **end-to-end program**
- NEWS is an **experiment** in the power of coordination, integration and teamwork

NEWS Objectives:

- Develop and deploy experimental **E&WC global observing system**
- **Document the global E&WC** by obtaining complete observational record of all associated relevant geophysical properties
- Build **fully interactive global climate model** that encompasses process-level E&WC forcings and feedbacks – *Climate models that can predict weather-scale extremes*
- Create global surface and atmosphere **data assimilation system for E&WC variables**
- **Assess variability of the global E&WC** on time scales ranging from seasonal to decadal, and space scales ranging from regional to continental to global
- Support the **application of climate prediction capabilities** for estimating the impact of climate variability and change on water resources

NEWS Highlights (November 2009)

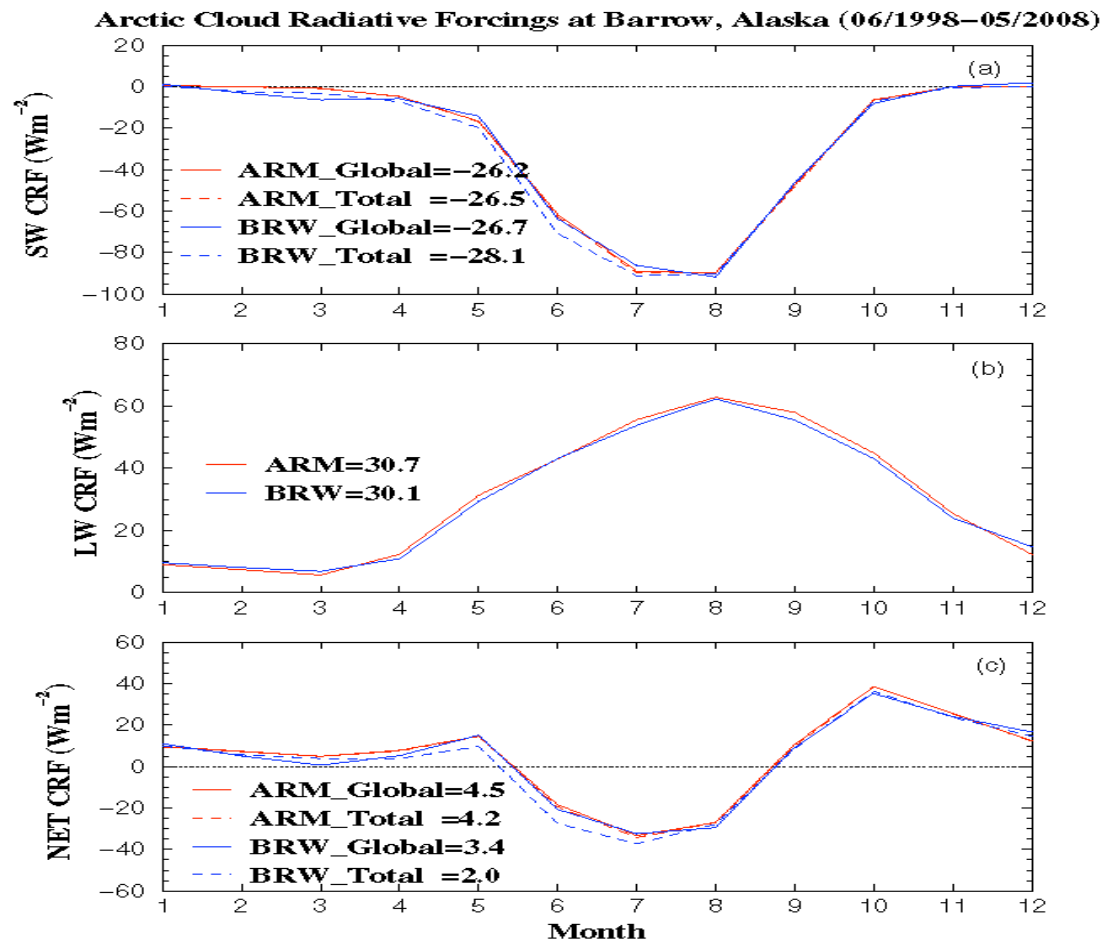
A 10-yr Climatology of Cloud Radiative Forcing (CRF) at Barrow, Alaska

Xiqun Dong, Baike Xi, and Kathy Crosby
University of North Dakota

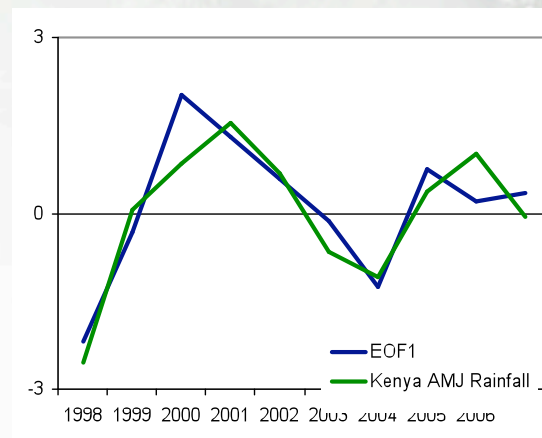
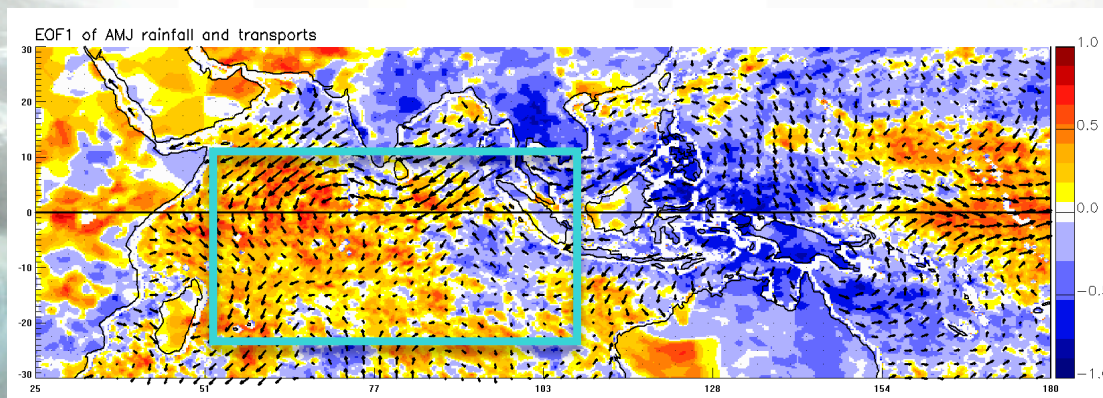
Charles N. Long
DOE PNNL

Robert S. Stone
CIRES/Colorado Uni.; ESRL/NOAA

- LW CRFs are minimum (6 Wm^{-2}) in March, then increase monotonically to reach maximum (63 Wm^{-2}) in August, then decrease continuously to the following March.
- The cycle of SW CRF mirrors its LW counterpart with the greatest negative impact occurring during the snow free months of July and August.
- On annual average, the negative SW CRF and positive LW CRFs nearly cancel, resulting in annual average NET CRF of about 3.5 Wm^{-2} on the basis of the combined ARM and BRW analysis.
- Compared with other studies, we find that LW CRF does not change over the Arctic regions significantly, but NET CRFs change from negative to positive from Alaska to the Beaufort Sea, indicating that Barrow is at a critical latitude for neutral NET CRF. Dong et al. 2009, JGR-atmos.



Rainfall Over Land is Related to Water Vapor Transport From the Ocean



- Rainfall over eastern Africa and the Indian subcontinent are strongly correlated with patterns in water vapor transport over the Indian ocean; the example above shows the correlation for Kenya
- Chris Funk is using water vapor transport data developed by NEWS to monitor and predict rain anomalies over Africa and India
- Kyle Hilburn (working with Chris) has developed an experimental version of his water vapor transport dataset using QuikSCAT data to provide on-going climate monitoring capabilities updated every 10 days; these data are being evaluated by Chris

Extremes in Daily Precipitation – Climate is More than Averages

Science issue: Determine recent climatology of extremes in precip as a first step in characterizing the satellite-era record and seeking fluctuations/trends

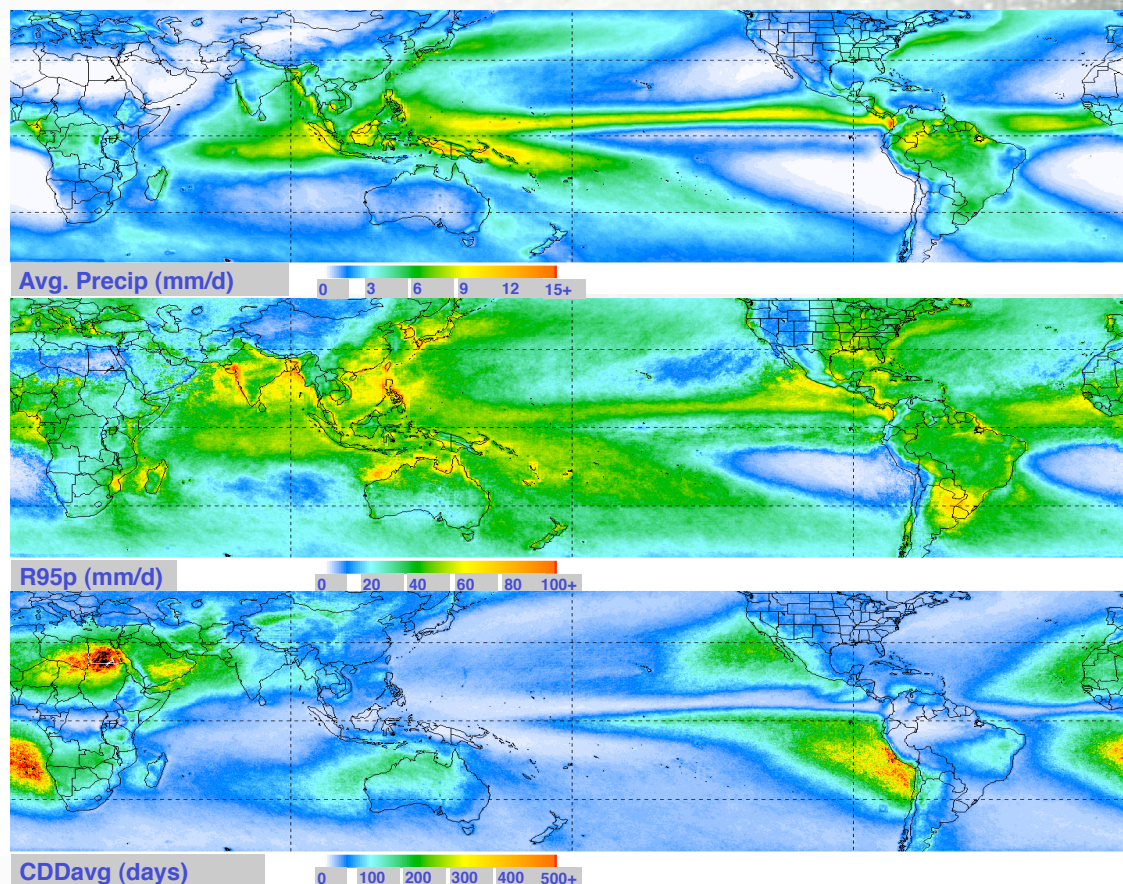
Approach: Test a range of definitions of “extreme” with high quality satellite data sets and gauge validation

Satellite-based data: TRMM Multi-satellite Precipitation Analysis (TMPA) 3-hr data

Project status: With funding by NEWS and PMM, G.J. Huffman (SSAI; GSFC), R.F. Adler (UMD; GSFC)

- Developed 11-year climatologies for several standard “extremes” variables
- Demonstrated reasonable behavior against 6 years of gauge data for various climate zones
- Worked to select stable definitions of “extreme”; generally parameters depending on a few values are less stable than those using more data
- Beginning to examining seasonality of “extremes” parameters

Huffman, G.J., R.F. Adler, D.T. Bolvin, E.J. Nelkin, 2008: Validation and Analysis of Precipitation Extremes in the TMPA. 4th Workshop of the IPWG, 13-17 October 2008, Beijing, China, <http://www.isac.cnr.it/~ipwg/meetings/beijing/4th-IPWG-Proceedings-web-March-2009.pdf>, 154-161; <http://www.isac.cnr.it/~ipwg/meetings/beijing/pres/Huffman.ppt>.



Example “extremes” in daily precip from the TMPA for 1998-2008: rain rate for the 95th percentile (R95p; middle); average longest run of dry days in a year (CDDavg; bottom). Although closely related to the avg. precip (top), there are important and interesting differences, such as the R95p maxima on the southern coast of Mexico and in South America’s la Plata basin, and the small CDDavg gradient in the SPCZ.